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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/622,889	07/17/2003	Xueying Huang	CL1941 US NA	2771

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WILMINGTON, DE 19805

EXAMINER

TSOY, ELENA

ART UNIT	PAPER NUMBER
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1762

DATE MAILED: 08/31/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/622,889

Applicant(s)

HUANG ET AL.

Examiner

Elena Tsoy

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 14 August 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-30 is/are pending in the application.
- 4a) Of the above claim(s) 8,9,19-28 and 30 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-7,10-18 and 29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on August 14, 2006 has been entered. Claims 1-30 are pending in the application. Claims 8, 9, 19-28, and 30 are withdrawn from consideration as directed to a non-elected invention.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-3, 5-7, 10-12, 14-18, and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murray et al (Annu. Rev. Mater. Sci. 2000, 30, 545-610) in view of GB487055.

Murray et al teach that the most established methods of preparation of metal nanocrystals (NCs) involve *aqueous* reduction of metal salts (notably Au or Ag) in the presence of **citrate anions** (claimed electrolyte). The formed colloids having $10 < \sigma < 15\%$ are electrostatically stabilized by the adsorption of ions to the NCs surface during growth. Flocculation of these colloids is irreversible, preventing further processing to achieve the desired $\sigma \sim 5\%$. **Chemisorption of organic ligands** (capping groups) the surface of metal NCs is essential to permit further handling. See page 549, §2). Murray et al further teach that coupling the initial synthesis with extensive use of **size-selective precipitation** allows narrowing down the initial size distribution to $\sigma \leq 5\%$ (See page 549, §3, 4; page 550, §1). NCs are stable with respect to aggregation only if the capping groups provide a repulsive force of sufficient strength and range

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to counteract the inherent van der Waals attraction between NCs. The energetic barrier to aggregation provided by the capping groups is strongly dependent on the energy of mixing between the tethered capping groups and the solvent. Introduction of **non-solvent, miscible with the original dispersing solvent**, *destabilizes* the NC dispersions. The NCs then aggregate and precipitate leaving many of the synthetic by-products in solution. If the capping groups are well bound to the surface of the NCs, the resulting powders are redispersible in a variety of solvents. Repeated flocculation and redispersion of the NCs in fresh solvents allow the isolation of powders composed of the desired NCs and their intimate organic capping layer. A straightforward extension of the precipitation process allows the isolation of size-selected fractions of NCs. See page 552, §2. **Size-selective precipitation** involves addition of a non-solvent into the dispersion. Since the largest NCs in the size distribution exhibit the greatest attractive van der Waals forces, they tend to aggregate before the smaller NCs. If the dispersion is allowed to only partially flocculate, **filtering** or **centrifuging** the suspension isolates a precipitate enriched in the larger NCs and leaves the smaller NCs dispersed in the supernatant. The precipitate can be redispersed in a solvent and subjected to this gentle flocculation procedure to further narrow the size distribution. Similarly, gradual addition of more nonsolvent to the decanted supernatant brings about a precipitation of a second size fraction. See page 552, §3.

Murray et al fail to teach that nonsolvent for adding to the aqueous stable colloids is an organic solvent.

GB487055 teaches that a mixture of alcohol and ether can be used as non solvent for post precipitation treatment of aqueous colloids of metals such as Au or Ag stabilized with organic polymer and salt (See column 1 and 2). Obviously, the mixture is miscible with water because it destabilizes the aqueous colloids.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used a water miscible mixture of alcohol and ether as nonsolvent in Murray et al with the expectation of providing the desired size-selective precipitation.

As to claim 3, It is the Examiner's position that the chemisorption of organic ligands forms a monolayer.

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As to claim 12, Murray et al do not expressly teach that sodium citrate is source of citrate anions. However, since Murray et al do not limit the teaching to the particular salts, obviously, any water-soluble citrates including sodium citrate may be used as a source of citrate anions.

As to the choice of a mixture of anti-solvents, Murray et al fail to teach that non-solvent is methanol or ethanol (Claims 14, 15); or a mixture of methanol and ethyl acetate (Claim 17). However, one of ordinary skill in the art at would understand that the choice of anti-solvents would depend on particular monolayer coating used. Note that claimed organic solvents include conventional organic solvents. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have discovered the optimum mixtures of anti-solvents (including those of claimed invention) in a method of Murray et al in view of GB487055 through routine experimentation in the absence of showing of criticality.

It is held that it is not inventive to discover the optimum or workable ranges of result-effective variables by routine experimentation. In re Antonie, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). See also In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

4. Claims 1-3, 5-7, 10, 11, 14-18, and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over GB487055 in view of Murray et al.

GB487055 discloses a method for preparing *stable* colloidal aqueous dispersions of metals such as bismuth, silver and gold nanoparticles (See column 1, lines 10-31) by forming first metal nanoparticles, then adding a water soluble hydroxymethylcellulose and aqueous solution of sodium lysalbinate and sodium protalbinate (claimed electrolyte) thereby providing a colloidal dispersion (colloidal solution) of stabilized, charged metal nanoparticles dissolved in an aqueous solution containing an electrolyte, as required by steps a) and b) of claim 1; and precipitating the metal nanoparticles by adding alcohol and ether followed by redispersing in water (See columns 1 and 2). GB487055 teaches that hydroxymethylcellulose and salts of lysalbinic acid or protalbinic acid *per se* do not form in many cases permanently stable colloidal dispersions of metals, a post precipitation treatment by adding a mixture of alcohol and ether provides colloidal dispersions of metals which are stable for a year or more (See column 1, lines 32-38). Therefore, it could be assumed that the post precipitation treatment forms metal particles of more narrow size distribution, especially considering the fact that it is generally known that

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chemical synthesis usually results in nanoparticles with a broad size distribution, as admitted by Applicants (See specification, page 1, lines 34-25).

GB487055 fails to teach that non-solvent mixture of alcohol and ether is substantially miscible with water (Claim 1); alcohol is methanol, ethanol (Claims 14, 15); non-solvent is a mixture of methanol and ethyl acetate (Claim 17).

Murray et al teach that (any) non-solvent, miscible with the *original* dispersing solvent, *destabilizes* the NC dispersions (See page 552, §2).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used any non-solvent or non-solvent mixture in GB487055 including a mixture of any alcohol and ether that is miscible with water with the expectation of providing the desired precipitation since Murray et al teach that any non-solvent, miscible with the original dispersing solvent, destabilizes the NC dispersions.

Obviously, alcohol would include conventionally used methanol, ethanol and isopropanol.

As to the choice of a mixture of anti-solvents, one of ordinary skill in the art at would understand that the choice of anti-solvents would depend on particular monolayer coating used. Note that claimed organic solvents include conventional organic solvents. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have discovered the optimum mixtures of anti-solvents (including those of claimed invention, e.g. a mixture of methanol and ethyl acetate) in a method of GB487055 in view of Murray et al through routine experimentation in the absence of showing of criticality.

As to claim 18, GB487055 fails to teach that filtering or centrifuging may be used for isolation of metal nanoparticles.

Murray et al teach that that filtering or centrifuging may be used for isolation of metal nanoparticles (See above).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used filtering or centrifuging for isolation of metal nanoparticles in GB487055. Murray et al teach that that filtering or centrifuging may be used for isolation of metal nanoparticles.

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5. Claims 4, 14-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murray et al in view of GB487055, further in view of Templeton et al (Langmur, 1999,15, pp 66-76).

Murray et al in view of GB487055 are applied here for the same reasons as above.

Murray et al in view of GB487055 fail to teach that the chemisorbed organic ligands is tiopronin or coenzyme A (Claim 4); the organic solvent is methanol or ethanol (Claim 14); the substantially water-miscible organic solvent is a mixture of organic solvents (Claim 16); the mixture of organic solvents are combinations selected from the group consisting of ethyl acetate and methanol; ethyl acetate and ethanol; ethyl acetate and isopropanol; ethyl acetate and acetone; ethyl acetate, dimethylformamide, and dimethyl sulfoxide; and ethyl acetate, tetrahydrofuran, and dioxane (Claim 17).

Templeton et al teach that tiopronin or coenzyme A may be used for preparing monolayer-protected gold nanoparticles (See page 67, column 2, beginning of paragraph 3); and the monolayer-protected gold nanoparticles are completely **insoluble** in methanol but quite soluble in water (See page 67, column 2, beginning of paragraph 4). Obviously, tiopronin or coenzyme A having SH group are chemisorbed on the surface of Au or Ag particles since it is well known in the art that SH group readily chemisorbs on the Au or Ag surface.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used tiopronin or coenzyme A as organic ligand in Murray et al in view of GB487055 with the expectation of providing the desired monolayer-protected gold nanoparticles since Templeton et al teach that tiopronin or coenzyme A may be used for preparing monolayer-protected gold nanoparticles.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used a mixture of methanol and ether as non-solvent that is miscible with the original dispersing solvent in Murray et al in view of GB487055 with the expectation of providing the desired destabilization of the NC dispersions since Templeton et al teach that tiopronin or coenzyme A protected gold nanoparticles are completely insoluble in methanol.

It is well known in the art that ethyl acetate is a conventionally used solvent that is insoluble in water. Therefore, ethyl acetate may be used instead of ether in Murray et al in view of GB487055 depending on particular protecting layer.

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6. Claims 12 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murray et al in view of GB487055, further in view of Natan et al (US 6,149,868).

Murray et al in view of GB487055 are applied here for the same reasons as above.

Murray et al in view of GB487055 fail to teach that the source of anion is sodium citrate (Claim 12) or sodium chloride (Claim 13).

Natan et al teach that colloidal Ag and Au particles are negatively-charged, due to adsorbed citrate and chloride ions present during their preparation, and organic ligand adsorbs to negatively-charged surfaces (See column 10, lines 8-10). The colloidal Ag and Au particles may be prepared either using sodium citrate (See column 6, line 16) or sodium chloride (See column 6, lines 60-63).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used methods with use of either sodium citrate or sodium chloride for preparing colloidal negatively-charged Ag and Au particles having adsorbed anions in Murray et al in view of GB487055 since Natan et al teach that colloidal Ag and Au particles negatively-charged due to adsorbed citrate and chloride ions may be prepared either using sodium citrate or sodium chloride.

Response to Arguments

7. Applicant's arguments with respect to claims 1-7, 10-18, 29 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Elena Tsoy whose telephone number is 571-272-1429. The examiner can normally be reached on Monday-Thursday, 9:00AM - 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on 571-272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Elena Tsoy
Primary Examiner
Art Unit 1762

ELENA TSOY
PRIMARY EXAMINER
ETsoy

August 29, 2006